



Kousidis Engineering, LLC
Land Development Consultants & Site Design

DRAINAGE ANALYSIS

LOCATED AT
**41 RICHMONDVILLE AVENUE
WESTPORT, CONNECTICUT**

PREPARED FOR
41 RICHMONDVILLE LLC

December 12, 2019
Revised: January 13, 2020
Revised: January 31, 2020
Last Revised: February 04, 2020

Jim Kousidis, P.E.
CT License No. 26830

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Note: This report has been amended to reflect changes to the Site Development Plan set provided by Kousidis Engineering, LLC dated December 12, 2019, last revised, February 04, 2020 for adjustments made to the drainage systems.

1. EXISTING CONDITIONS

This 104,798-sq. ft. residential property is currently developed with an office complex and a large driveway and a parking lot. Test pits at the site indicate highly pervious soils that are adequate to accept a subsurface storm drain system. The topography of the property slopes to Lee's Canal, located at the southwest portion of the property. According to the Web Soil Survey website (map and soil table attached) the soils in the subject area consist of Udorthents-Urban land complex, a well-drained soil with a Hydrologic Soil Group "B".

There is an existing wetlands pocket located in the southwest corner of the property that is associated with Lee's Canal, which connects to the Saugatuck River. The impervious surfaces on the property consist of approximately 27,185 sq.ft. of building and 50,287 sq.ft. of asphalt driveway. These impervious surfaces discharge directly into the wetlands without any environmental treatment.

2. PROPOSED CONDITIONS

A new development is being proposed for the subject property. The owner is proposing to demolish the non-historic portion of the existing structure, refurbish the main structure and construct a new apartment complex with an attached garage, detached garages, new driveway, and new parking layout, with associated site improvements. The total proposed impervious surface is 64,450 sq.ft., a reduction of 16.8% over existing impervious area conditions.

Stormwater retention systems will be installed to satisfy the Town of Westport's requirements of zero increase in runoff for a 24-hour, type III rainfall, 25-year storm event. The new roof area and the driveway drains must be directed to the proposed retention systems as depicted on the plan set provided by Kousidis Engineering, LLC dated 12/12/2019, revised February 04, 2020.

Although there is an overall significant reduction in impervious areas for this development, we have provided stormwater treatment mitigation for all new impervious surfaces. The stormwater analysis and design assumes a conservative approach where the entire existing asphalt area and the portions of the building to be removed, are to be covered by good condition lawn. The primary drainage structure is a rain garden with Cultec R-150 XLHD rechargers beneath, supported by a second smaller rain garden and two bio-filtration swales. The swales and rain gardens have been designed to handle the water quality volume capacity as well as meet the requirements of zero increase in runoff for a 24-hour, type III rainfall, 25-year storm event. The northern bioswale (BS#1) is to collect a portion of the driveway and main structure before being discharged into the southern bioswale (BS#2). This bioswale will also collect a significant portion of the driveway area. This bioswale then discharge into the primary rain garden (RG#1) which will also collect the runoff from garage #1, garage #2 and a portion of the driveway area. The southwest raingarden (RG#2) will collect the runoff from garage #3 & garage #4 as well as the remaining portion of the driveway area.

3. DRAINAGE

Under existing conditions, the peak runoff from the site is 7.83 cfs for the 25-year storm, with the conservative approach of all existing asphalt areas and portions of the building being removed, be covered by good condition lawn. The Town's requirement for zero increase in runoff is satisfied by collecting the entire roof and the driveway drain inlets. The runoff from the impervious surface area directed to the primary rain garden (RG1) generates a peak 25-year flow of 2.01 cfs (PA1). The runoff from the impervious surface area directed to the secondary rain garden (RG2) generates a peak 25-year flow of 3.43 cfs (PA2). The runoff from the impervious surface area directed to bioswale #1 generates a peak 25-year flow of 3.10 cfs (PA3A&PA3B&PA3C). The runoff from the impervious surface area directed to bioswale #2 generates a peak 25-year flow of 1.63 cfs (PA4). The overall post conditions runoff is 6.68 cfs. The primary drainage system #1 consists of a 300 sq.ft. rain garden with 12 units of Cultec R-150 XLHD Rechargers beneath which discharges over an overflow weir. Subsurface drainage system #2 consists of a 315 sq.ft. rain garden with 8 units of Cultec R-150 XLHD Rechargers beneath which discharges over an overflow weir.

In addition to the above, the drainage systems were checked for the capacity to hold the first flush from all the new impervious surfaces. The water quality volume has been controlled by the bioswales and rain gardens. The runoff directed to the two rain gardens and two bioswales will control the required water quality prior to discharge to the wetlands. The runoff volume from 1" of rainfall from the impervious surfaces directed to the drainage systems is (57,800 sq. ft. x 1"/12"/ft. = 4,817 cu. ft.). The holding capacity of the drainage systems with only consideration for the biosoil mix and freeboard storage is 3,085 cu.ft. which translates to approximately 0.64" of pure storage volume. The holding capacity of the drainage systems with consideration for all drainage structures is 7,501 cu.ft. which well exceeds the 1" minimum requirement of pure storage volume.

4. CONCLUSION

Although the proposed development will not increase the amount of impervious surface to the site, we have provided full mitigation for the first flush of stormwater volume and the 24-hr, type III, 25-yr storm event. The proposed development will increase the amount of impervious area to this site, resulting in higher peak runoff rates. However, with the installation of the proposed stormwater retention systems, the original flow patterns will be maintained and there will be no increase in peak runoff for the 25-year storm event. In addition to controlling stormwater peak runoff, the proposed design incorporates stormwater treatment to control pollution and provide groundwater recharge capacity. The implementation of these techniques and the overall site design layout will result in a finished project that will minimize sediment and erosion impacts during construction and will have no adverse impacts to adjoining properties upon completion.

EXISTING DRAINAGE CONDITIONS

EXHIBIT "A"

41 RICHMONDVILLE AVENUE, WESTPORT, CT

PREPARED FOR

41 RICHMONDVILLE LLC



KOUSIDIS ENGINEERING, LLC

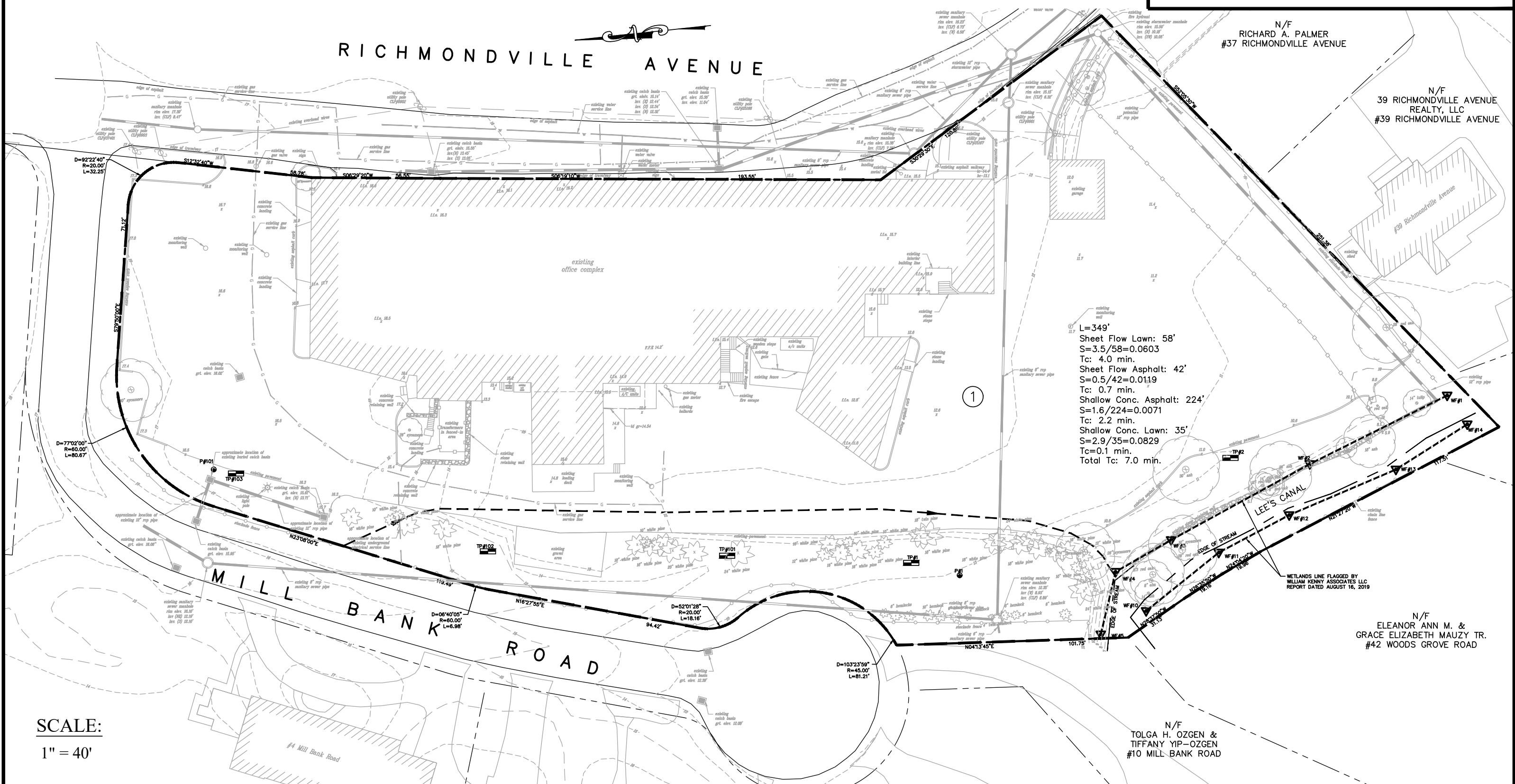
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PROPOSED DRAINAGE CONDITIONS

EXHIBIT "B"

41 RICHMONDVILLE AVENUE, WESTPORT, CT

PREPARED FOR

41 RICHMONDVILLE LLC

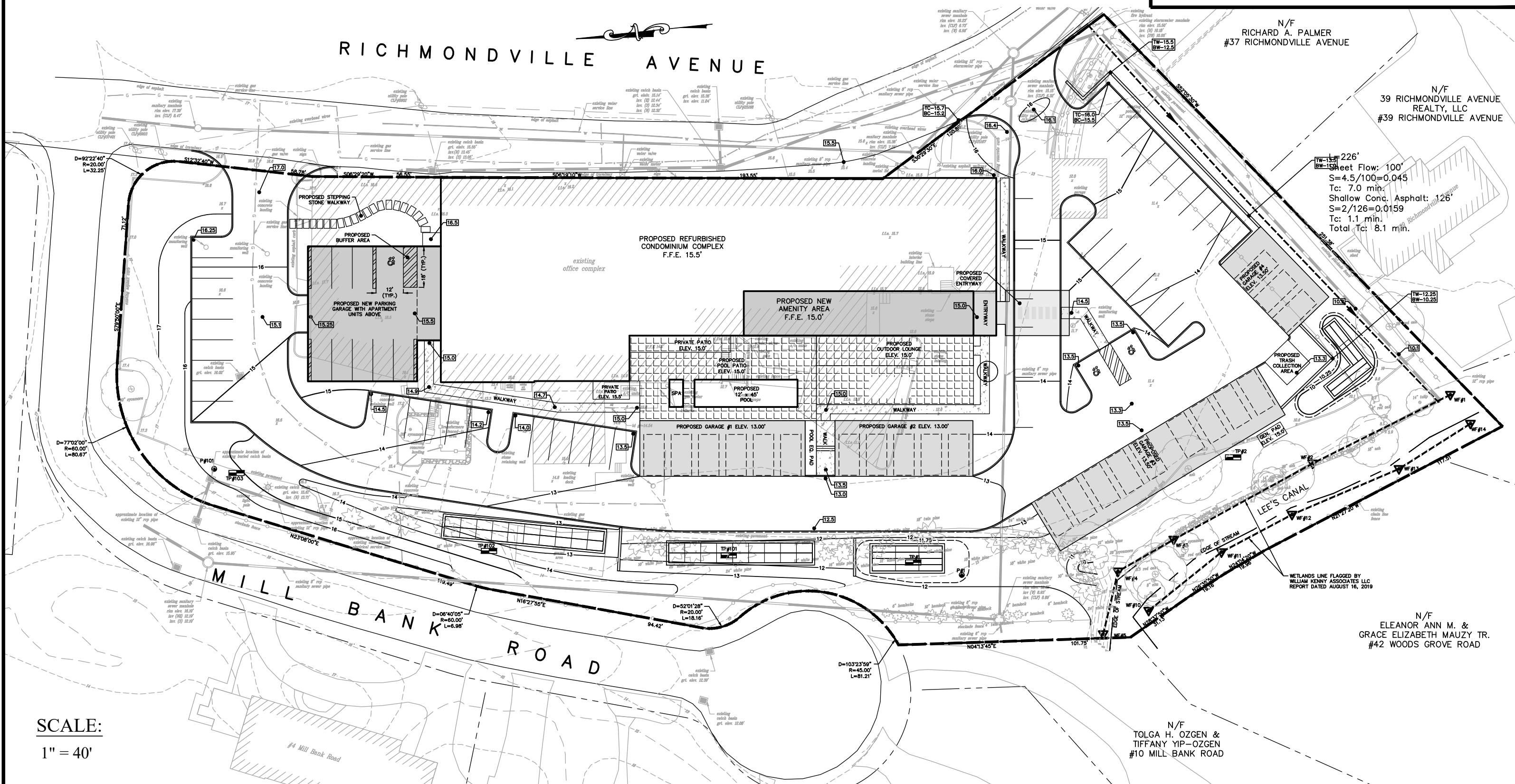


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PROPOSED AREA ROUTING

41 RICHMONDVILLE AVENUE, WESTPORT, CT

PREPARED FOR

41 RICHMONDVILLE LLC



KOUSIDIS ENGINEERING, LLC

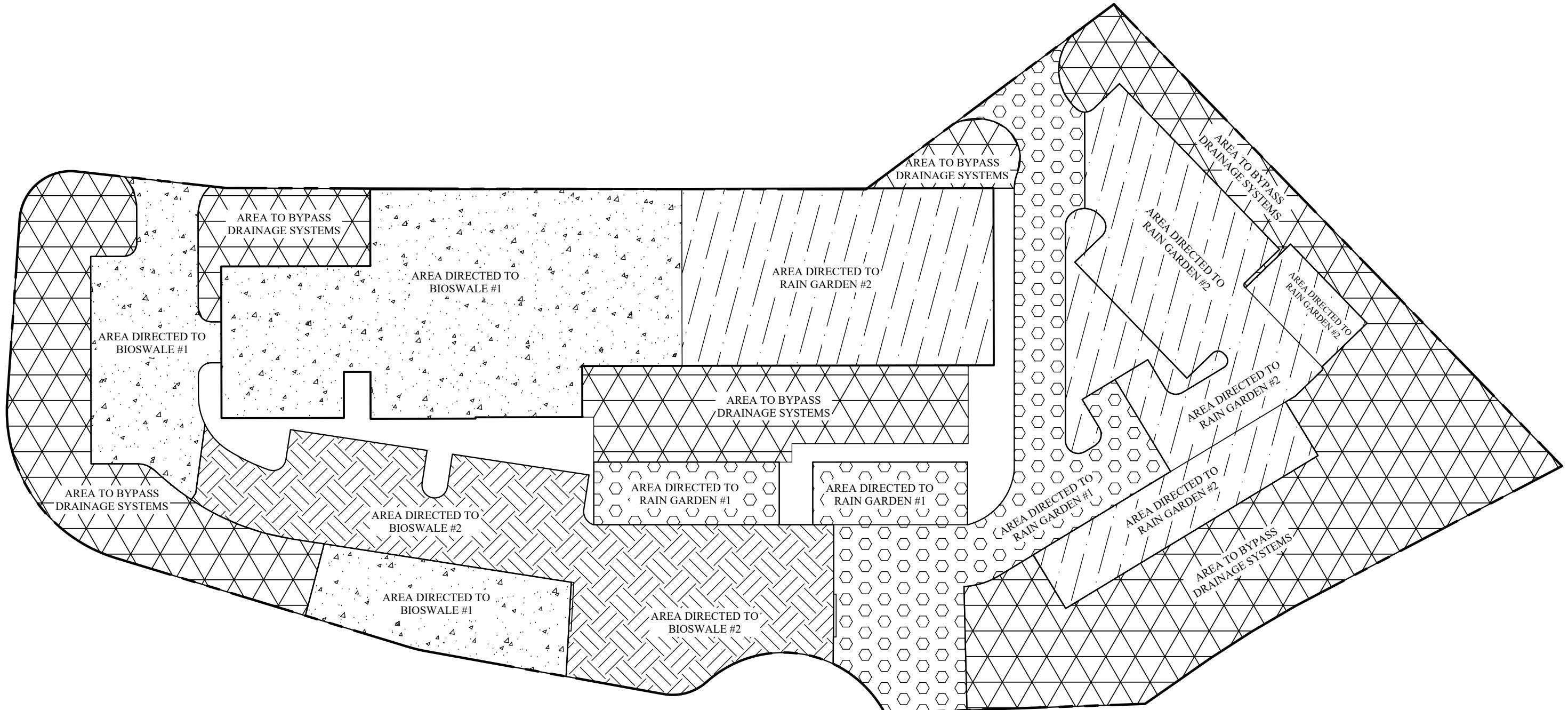
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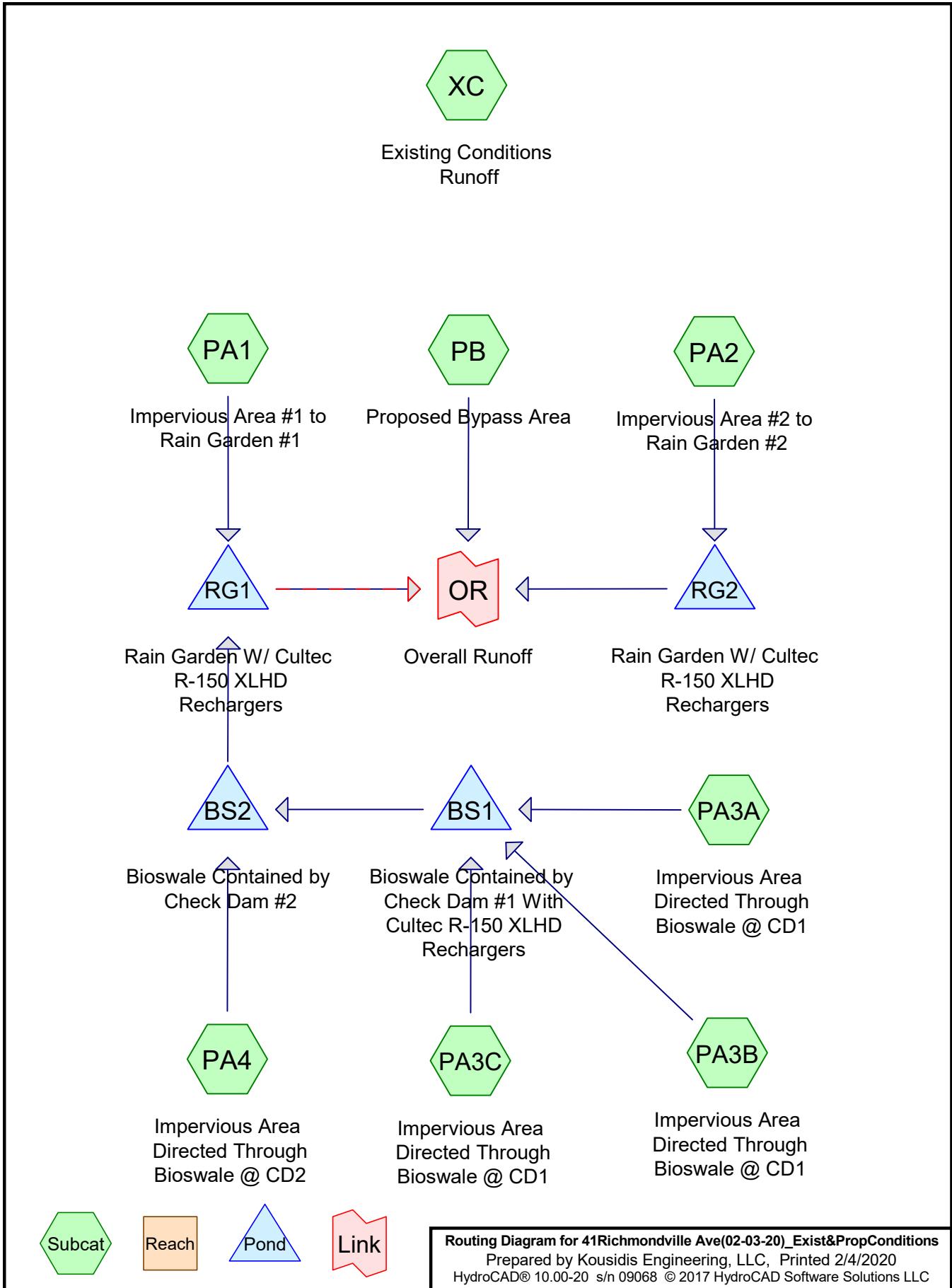
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SCALE:

1" = 40'



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PA1: Impervious Area #1 to Runoff Area=13,900 sf 78.42% Impervious Runoff Depth>5.23"
Tc=3.0 min CN=90 Runoff=2.01 cfs 6,064 cf

Subcatchment PA2: Impervious Area #2 to Runoff Area=22,400 sf 92.19% Impervious Runoff Depth>5.81"
Tc=3.0 min CN=95 Runoff=3.43 cfs 10,841 cf

Subcatchment PA3A: Impervious Area Runoff Area=7,500 sf 100.00% Impervious Runoff Depth>6.16"
Tc=3.0 min CN=98 Runoff=1.17 cfs 3,850 cf

Subcatchment PA3B: Impervious Area Runoff Area=6,250 sf 100.00% Impervious Runoff Depth>6.16"
Tc=3.0 min CN=98 Runoff=0.97 cfs 3,208 cf

Subcatchment PA3C: Impervious Area Runoff Area=7,500 sf 60.00% Impervious Runoff Depth>4.46"
Tc=3.0 min CN=83 Runoff=0.96 cfs 2,789 cf

Subcatchment PA4: Impervious Area Runoff Area=12,000 sf 66.67% Impervious Runoff Depth>4.79"
Tc=3.0 min CN=86 Runoff=1.63 cfs 4,789 cf

Subcatchment PB: Proposed Bypass Area Runoff Area=35,248 sf 18.87% Impervious Runoff Depth>3.22"
Flow Length=226' Tc=8.1 min CN=71 Runoff=2.80 cfs 9,457 cf

Subcatchment XC: Existing Conditions Runoff Area=104,798 sf 16.61% Impervious Runoff Depth>2.93"
Flow Length=359' Tc=7.0 min CN=68 Runoff=7.83 cfs 25,571 cf

Pond BS1: Bioswale Contained by Check Peak Elev=13.22' Storage=2,471 cf Inflow=3.10 cfs 9,848 cf
Discarded=0.30 cfs 7,918 cf Primary=2.66 cfs 1,922 cf Outflow=2.95 cfs 9,840 cf

Pond BS2: Bioswale Contained by Check Peak Elev=12.12' Storage=2,392 cf Inflow=3.99 cfs 6,712 cf
Discarded=0.31 cfs 5,404 cf Primary=2.07 cfs 1,303 cf Outflow=2.38 cfs 6,707 cf

Pond RG1: Rain Garden W/ Cultec R-150 Peak Elev=11.75' Storage=1,418 cf Inflow=2.90 cfs 7,367 cf
Discarded=0.46 cfs 5,109 cf Primary=1.16 cfs 2,256 cf Secondary=0.00 cfs 0 cf Outflow=1.62 cfs 7,365 cf

Pond RG2: Rain Garden W/ Cultec R-150 Peak Elev=10.36' Storage=1,233 cf Inflow=3.43 cfs 10,841 cf
Discarded=0.36 cfs 7,909 cf Primary=2.99 cfs 2,928 cf Outflow=3.35 cfs 10,837 cf

Link OR: Overall Runoff Inflow=6.23 cfs 14,642 cf
Primary=6.23 cfs 14,642 cf

Summary for Subcatchment PA1: Impervious Area #1 to Rain Garden #1

Runoff = 2.01 cfs @ 12.05 hrs, Volume= 6,064 cf, Depth> 5.23"

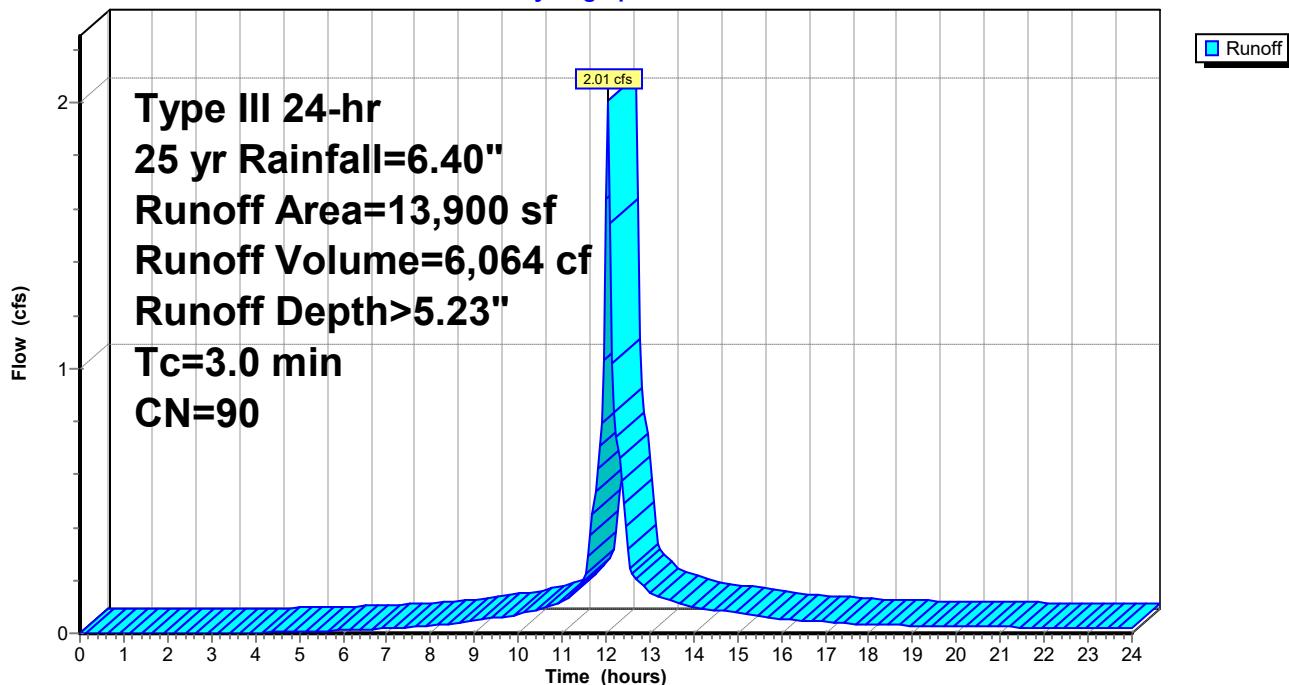
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
*	3,400	98 Building
*	7,500	98 Driveway
	3,000	>75% Grass cover, Good, HSG B
13,900	90	Weighted Average
3,000		21.58% Pervious Area
10,900		78.42% Impervious Area

Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					Direct Entry,

Subcatchment PA1: Impervious Area #1 to Rain Garden #1

Hydrograph



Summary for Subcatchment PA2: Impervious Area #2 to Rain Garden #2

Runoff = 3.43 cfs @ 12.05 hrs, Volume= 10,841 cf, Depth> 5.81"

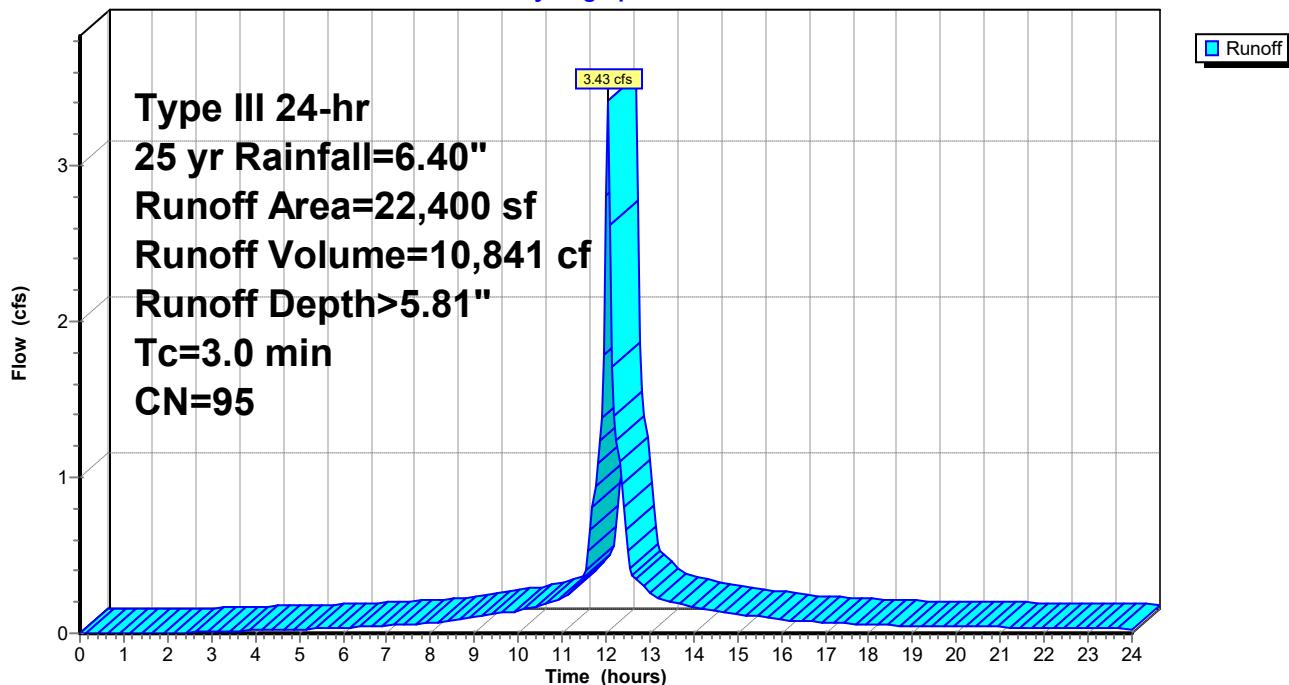
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
*	13,150	98 Building
*	7,500	98 Driveway
1,750	61	>75% Grass cover, Good, HSG B
22,400	95	Weighted Average
1,750		7.81% Pervious Area
20,650		92.19% Impervious Area

Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					Direct Entry,

Subcatchment PA2: Impervious Area #2 to Rain Garden #2

Hydrograph



Summary for Subcatchment PA3A: Impervious Area Directed Through Bioswale @ CD1

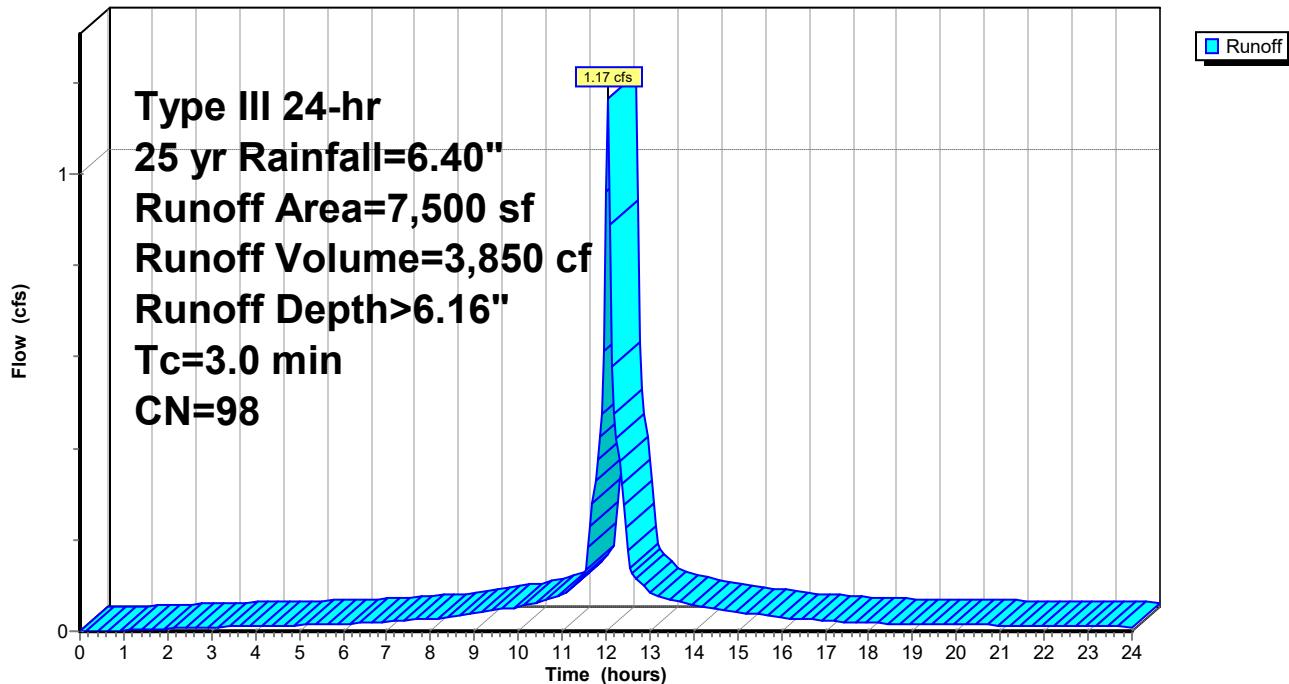
Runoff = 1.17 cfs @ 12.05 hrs, Volume= 3,850 cf, Depth> 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description			
*	7,500	98 Building			
*	0	Driveway			
		Weighted Average			
		7,500 100.00% Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
3.0					Direct Entry,

Subcatchment PA3A: Impervious Area Directed Through Bioswale @ CD1

Hydrograph



Summary for Subcatchment PA3B: Impervious Area Directed Through Bioswale @ CD1

Runoff = 0.97 cfs @ 12.05 hrs, Volume= 3,208 cf, Depth> 6.16"

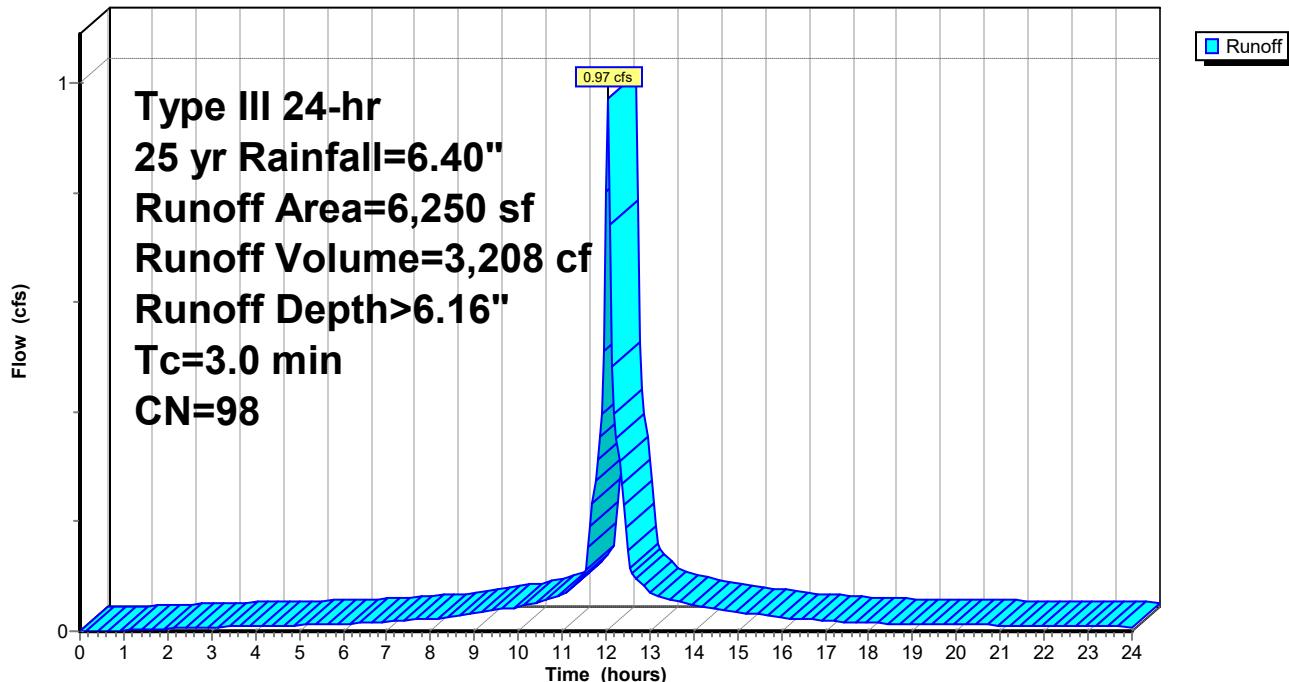
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
*	6,250	98 Building
*	0	Driveway
		Weighted Average
6,250	98	100.00% Impervious Area

Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					Direct Entry,

Subcatchment PA3B: Impervious Area Directed Through Bioswale @ CD1

Hydrograph



Summary for Subcatchment PA3C: Impervious Area Directed Through Bioswale @ CD1

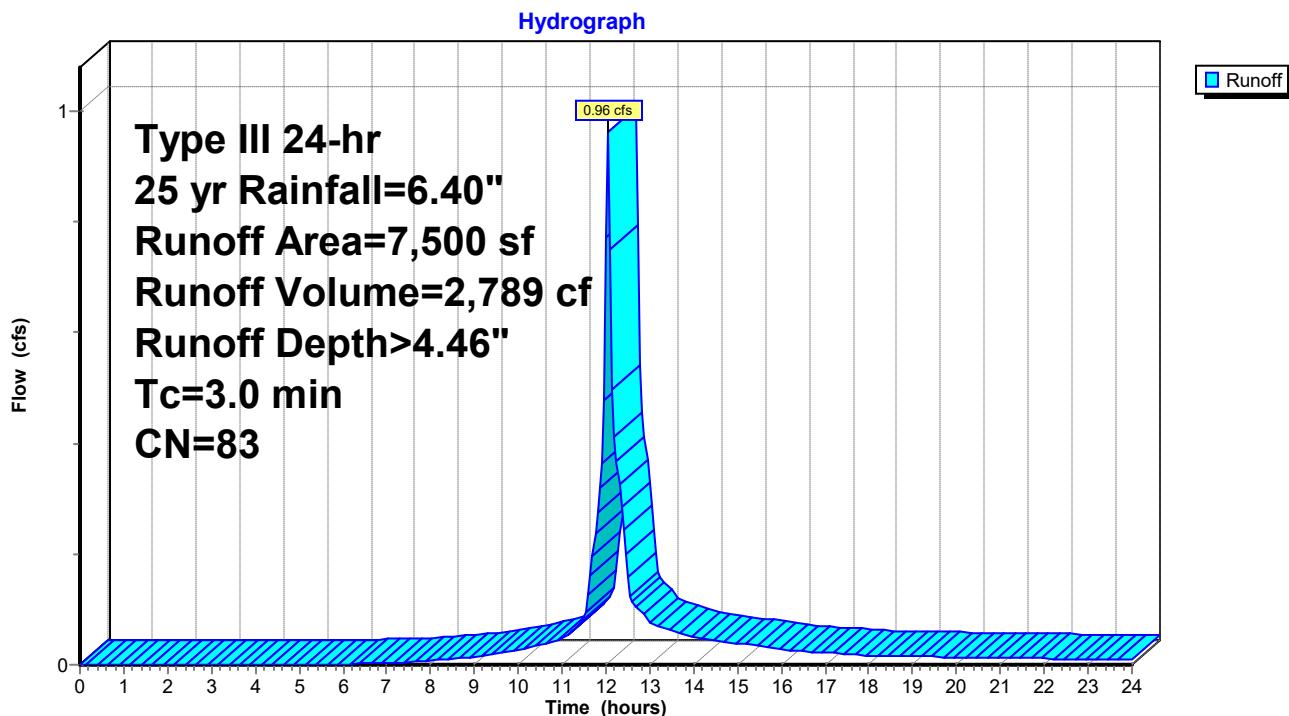
Runoff = 0.96 cfs @ 12.05 hrs, Volume= 2,789 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
3,000	61	>75% Grass cover, Good, HSG B
*	4,500	Driveway
7,500	83	Weighted Average
3,000		40.00% Pervious Area
4,500		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					Direct Entry,

Subcatchment PA3C: Impervious Area Directed Through Bioswale @ CD1



Summary for Subcatchment PA4: Impervious Area Directed Through Bioswale @ CD2

Runoff = 1.63 cfs @ 12.05 hrs, Volume= 4,789 cf, Depth> 4.79"

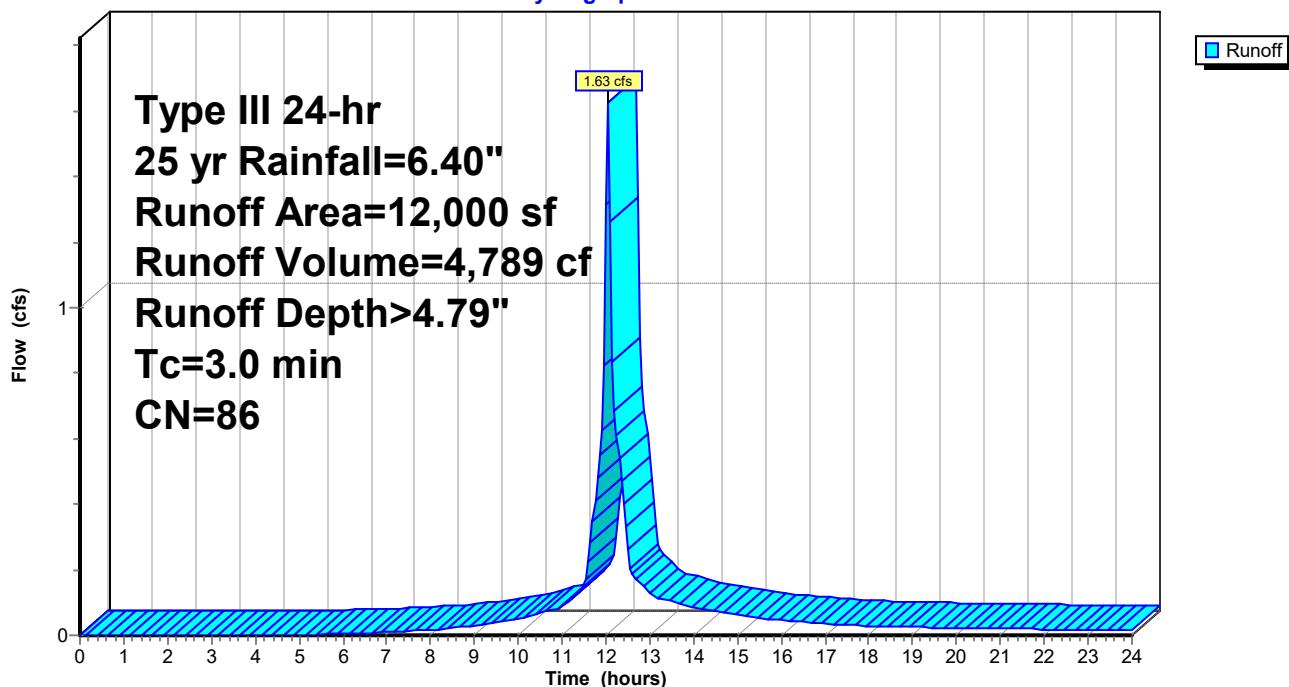
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
*	0	Building
*	8,000	Driveway
4,000	61	>75% Grass cover, Good, HSG B
12,000	86	Weighted Average
4,000		33.33% Pervious Area
8,000		66.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					Direct Entry,

Subcatchment PA4: Impervious Area Directed Through Bioswale @ CD2

Hydrograph



Summary for Subcatchment PB: Proposed Bypass Area

Runoff = 2.80 cfs @ 12.12 hrs, Volume= 9,457 cf, Depth> 3.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
*	0	Building
*	0	Driveway
*	6,000	Patio/Walks
*	650	Pool
*	3,308	<50% Grass cover, Poor, HSG D (Wetlands)
25,290	61	>75% Grass cover, Good, HSG B

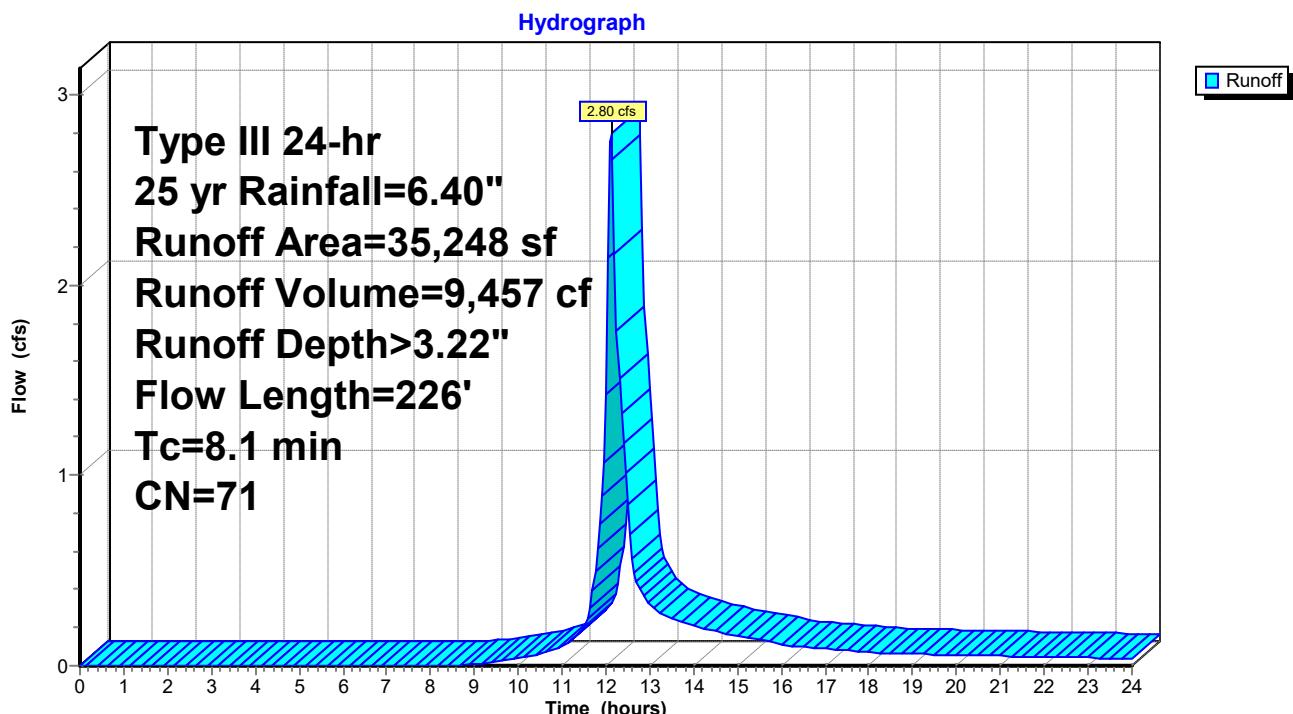
35,248 71 Weighted Average

28,598 81.13% Pervious Area

6,650 18.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0450	0.24		Sheet Flow, Sheet Flow Grass: Short n= 0.150 P2= 3.30"
1.1	126	0.0159	1.89		Shallow Concentrated Flow, Shallow Concentrated Flow Grassed Waterway Kv= 15.0 fps
8.1	226	Total			

Subcatchment PB: Proposed Bypass Area



Summary for Subcatchment XC: Existing Conditions Runoff

Runoff = 7.83 cfs @ 12.11 hrs, Volume= 25,571 cf, Depth> 2.93"

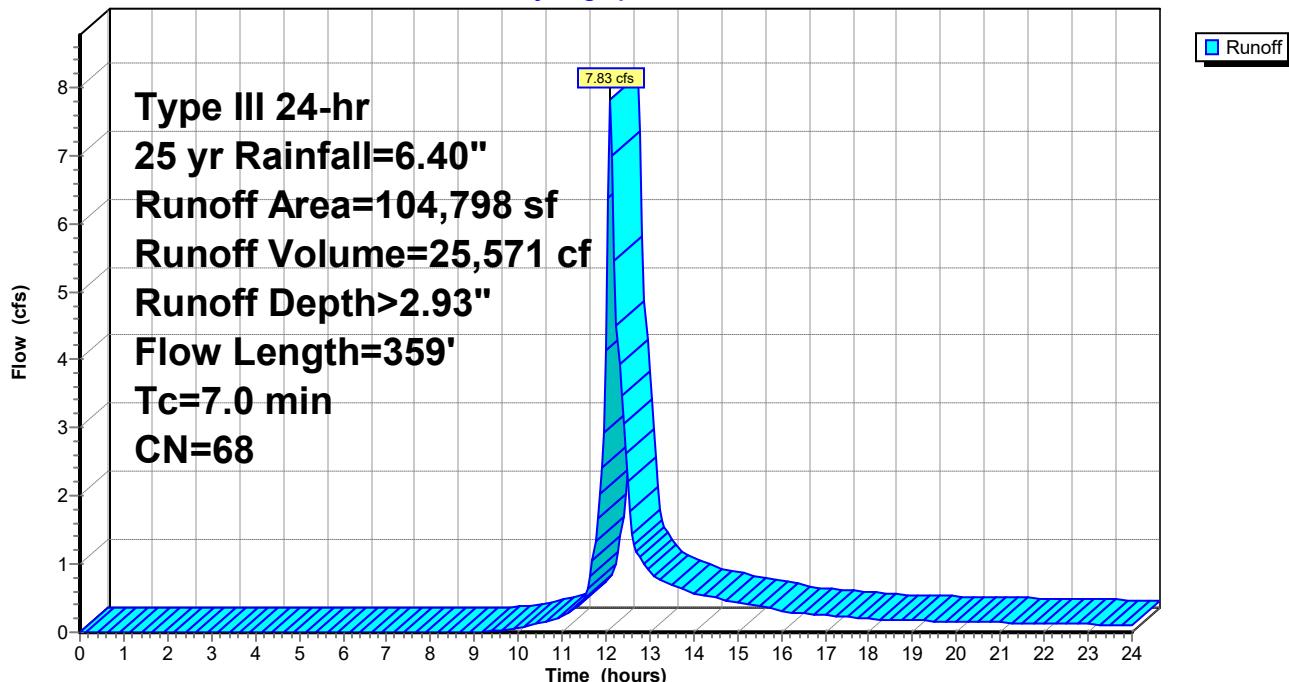
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.40"

Area (sf)	CN	Description
*	17,406	98 Building
*	3,308	<50% Grass cover, Poor, HSG D (Wetlands)
84,084	61	>75% Grass cover, Good, HSG B
104,798	68	Weighted Average
87,392		83.39% Pervious Area
17,406		16.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	58	0.0603	0.24		Sheet Flow, Sheet Flow Lawn Grass: Short n= 0.150 P2= 3.30"
0.7	42	0.0119	0.95		Sheet Flow, Sheet Flow Asphalt Smooth surfaces n= 0.011 P2= 3.30"
2.2	224	0.0071	1.71		Shallow Concentrated Flow, Shallow Concentrated Asphalt Paved Kv= 20.3 fps
0.1	35	0.0829	4.32		Shallow Concentrated Flow, Shallow Concentrated Lawn Grassed Waterway Kv= 15.0 fps
7.0	359	Total			

Subcatchment XC: Existing Conditions Runoff

Hydrograph



Summary for Pond BS1: Bioswale Contained by Check Dam #1 With Cultec R-150 XLHD Rechargers

Inflow Area = 21,250 sf, 85.88% Impervious, Inflow Depth > 5.56" for 25 yr event
 Inflow = 3.10 cfs @ 12.05 hrs, Volume= 9,848 cf
 Outflow = 2.95 cfs @ 12.10 hrs, Volume= 9,840 cf, Atten= 5%, Lag= 3.0 min
 Discarded = 0.30 cfs @ 12.10 hrs, Volume= 7,918 cf
 Primary = 2.66 cfs @ 12.10 hrs, Volume= 1,922 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 13.22' @ 12.10 hrs Surf.Area= 2,540 sf Storage= 2,471 cf

Plug-Flow detention time= 82.3 min calculated for 9,840 cf (100% of inflow)
 Center-of-Mass det. time= 81.8 min (840.0 - 758.2)

Volume	Invert	Avail.Storage	Storage Description
#1	8.00'	604 cf	6.00'W x 7.00'L x 3.04'H Cultec Stone Bed x 20 2,554 cf Overall - 1,043 cf Embedded = 1,510 cf x 40.0% Voids
#2	8.50'	1,043 cf	Cultec R-330XLHD x 20 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
#3	11.00'	255 cf	Biosoil Storage (Conic) Listed below (Recalc) 850 cf Overall x 30.0% Voids
#4	12.00'	596 cf	Freeboard Storage (Conic) Listed below (Recalc)
		2,498 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
11.00	850	0	0	850
12.00	850	850	850	953

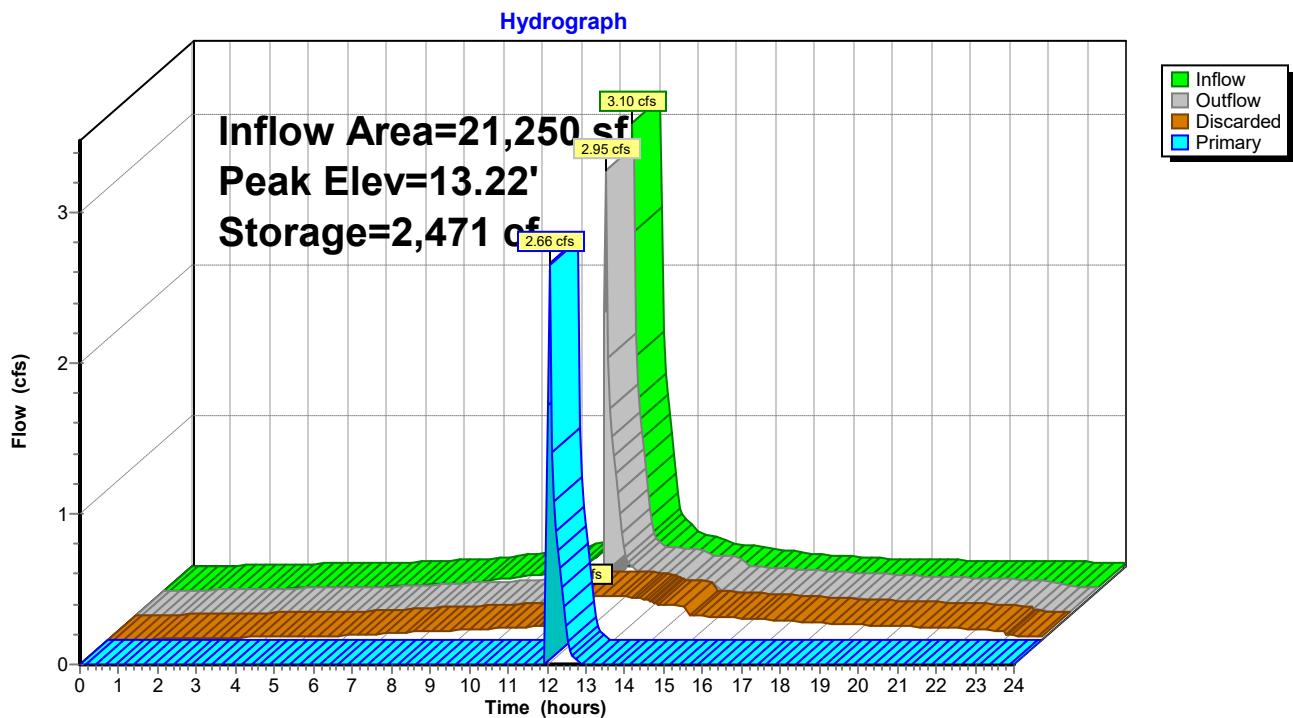
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
12.00	0	0	0	0
12.50	425	71	71	425
13.00	850	313	384	853
13.25	850	213	596	879

Device	Routing	Invert	Outlet Devices
#1	Primary	13.00'	8.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#2	Discarded	8.00'	3.000 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.30 cfs @ 12.10 hrs HW=13.22' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.30 cfs)

Primary OutFlow Max=2.57 cfs @ 12.10 hrs HW=13.21' (Free Discharge)
 ↑**1=Sharp-Crested Rectangular Weir** (Weir Controls 2.57 cfs @ 1.51 fps)

Pond BS1: Bioswale Contained by Check Dam #1 With Cultec R-150 XLHD Rechargers



Stage-Area-Storage for Pond BS1: Bioswale Contained by Check Dam #1 With Cultec R-150 XLHD Rechargers

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
8.00	840	0	13.20	4,247	2,456
8.10	892	34			
8.20	944	67			
8.30	996	101			
8.40	1,048	134			
8.50	1,100	168			
8.60	1,152	235			
8.70	1,204	301			
8.80	1,256	368			
8.90	1,308	434			
9.00	1,360	500			
9.10	1,412	566			
9.20	1,464	631			
9.30	1,516	695			
9.40	1,568	759			
9.50	1,620	823			
9.60	1,672	887			
9.70	1,724	950			
9.80	1,776	1,013			
9.90	1,828	1,074			
10.00	1,880	1,134			
10.10	1,932	1,194			
10.20	1,984	1,251			
10.30	2,036	1,308			
10.40	2,088	1,363			
10.50	2,140	1,416			
10.60	2,192	1,466			
10.70	2,244	1,514			
10.80	2,296	1,558			
10.90	2,348	1,598			
11.00	3,250	1,634			
11.10	3,281	1,673			
11.20	3,291	1,698			
11.30	3,302	1,724			
11.40	3,312	1,749			
11.50	3,322	1,775			
11.60	3,333	1,800			
11.70	3,343	1,826			
11.80	3,353	1,851			
11.90	3,364	1,877			
12.00	3,374	1,902			
12.10	3,391	1,903			
12.20	3,442	1,907			
12.30	3,527	1,918			
12.40	3,646	1,939			
12.50	3,800	1,973			
12.60	3,873	2,019			
12.70	3,953	2,073			
12.80	4,038	2,135			
12.90	4,130	2,206			
13.00	4,227	2,286			
13.10	4,237	2,371			

Summary for Pond BS2: Bioswale Contained by Check Dam #2

Inflow Area = 33,250 sf, 78.95% Impervious, Inflow Depth > 2.42" for 25 yr event
 Inflow = 3.99 cfs @ 12.09 hrs, Volume= 6,712 cf
 Outflow = 2.38 cfs @ 12.21 hrs, Volume= 6,707 cf, Atten= 40%, Lag= 7.1 min
 Discarded = 0.31 cfs @ 12.20 hrs, Volume= 5,404 cf
 Primary = 2.07 cfs @ 12.21 hrs, Volume= 1,303 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 12.12' @ 12.21 hrs Surf.Area= 2,856 sf Storage= 2,392 cf

Plug-Flow detention time= 81.2 min calculated for 6,707 cf (100% of inflow)
 Center-of-Mass det. time= 80.8 min (856.0 - 775.2)

Volume	Invert	Avail.Storage	Storage Description
#1	7.00'	544 cf	6.00'W x 7.00'L x 3.04'H Stone Bed x 18 2,298 cf Overall - 939 cf Embedded = 1,359 cf x 40.0% Voids
#2	7.50'	939 cf	Cultec R-330XLHD x 18 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
#3	10.00'	315 cf	Biosoil Storage (Conic) Listed below (Recalc) 1,050 cf Overall x 30.0% Voids
#4	11.00'	736 cf	Freeboard Storage (Conic) Listed below (Recalc)
		2,534 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
10.00	1,050	0	0	1,050
11.00	1,050	1,050	1,050	1,165

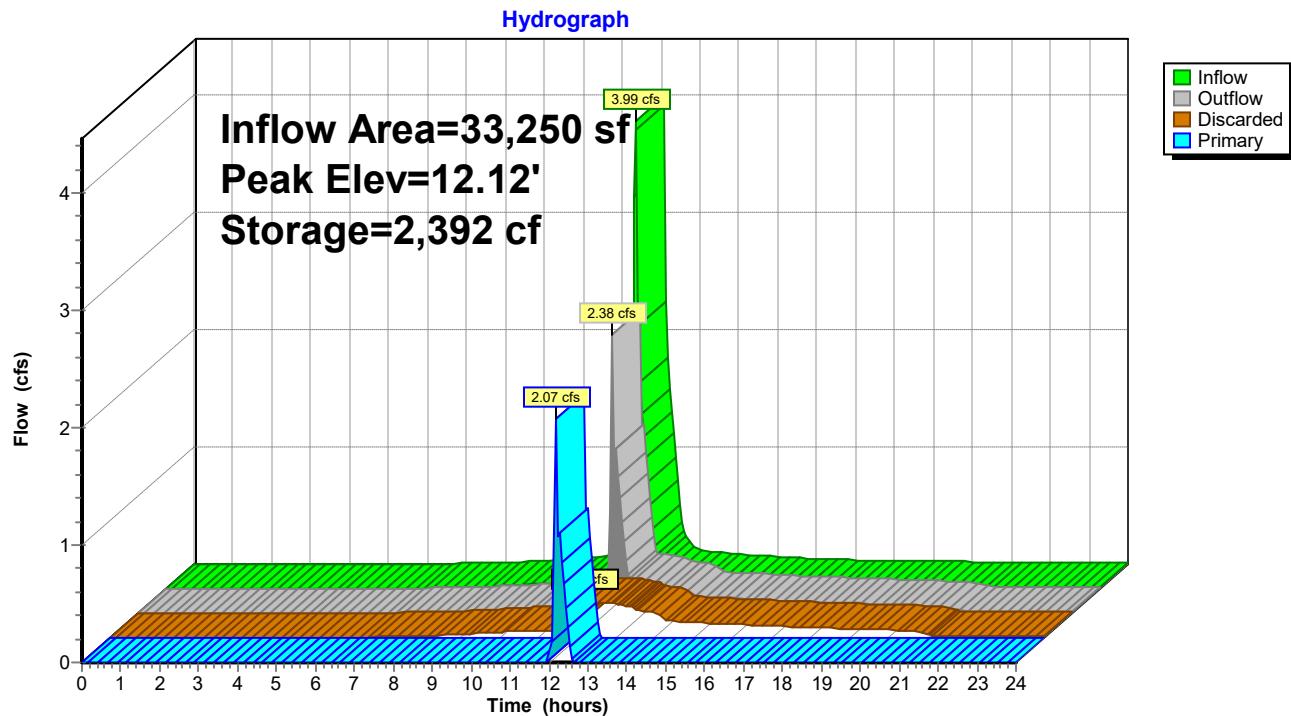
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
11.00	0	0	0	0
11.50	525	88	88	525
12.00	1,050	386	474	1,053
12.25	1,050	263	736	1,081

Device	Routing	Invert	Outlet Devices
#1	Primary	12.00'	16.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#2	Discarded	7.00'	3.000 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.31 cfs @ 12.20 hrs HW=12.11' (Free Discharge)
 ↑ 2=Exfiltration (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=1.90 cfs @ 12.21 hrs HW=12.11' (Free Discharge)
 ↑ 1=Sharp-Crested Rectangular Weir (Weir Controls 1.90 cfs @ 1.08 fps)

Pond BS2: Bioswale Contained by Check Dam #2



Stage-Area-Storage for Pond BS2: Bioswale Contained by Check Dam #2

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
7.00	756	0	12.20	4,419	2,481
7.10	803	30			
7.20	850	60			
7.30	896	91			
7.40	943	121			
7.50	990	151			
7.60	1,037	211			
7.70	1,084	271			
7.80	1,130	331			
7.90	1,177	391			
8.00	1,224	450			
8.10	1,271	509			
8.20	1,318	568			
8.30	1,364	626			
8.40	1,411	683			
8.50	1,458	741			
8.60	1,505	798			
8.70	1,552	855			
8.80	1,598	912			
8.90	1,645	967			
9.00	1,692	1,021			
9.10	1,739	1,074			
9.20	1,786	1,126			
9.30	1,832	1,177			
9.40	1,879	1,226			
9.50	1,926	1,274			
9.60	1,973	1,320			
9.70	2,020	1,363			
9.80	2,066	1,402			
9.90	2,113	1,438			
10.00	3,210	1,470			
10.10	3,240	1,514			
10.20	3,252	1,546			
10.30	3,263	1,577			
10.40	3,275	1,609			
10.50	3,286	1,640			
10.60	3,298	1,672			
10.70	3,309	1,703			
10.80	3,321	1,735			
10.90	3,332	1,766			
11.00	3,344	1,798			
11.10	3,365	1,798			
11.20	3,428	1,803			
11.30	3,533	1,816			
11.40	3,680	1,842			
11.50	3,869	1,885			
11.60	3,960	1,942			
11.70	4,058	2,008			
11.80	4,164	2,085			
11.90	4,276	2,172			
12.00	4,396	2,271			
12.10	4,408	2,376			

Summary for Pond RG1: Rain Garden W/ Cultec R-150 XLHD Rechargers

Inflow Area = 47,150 sf, 78.79% Impervious, Inflow Depth > 1.87" for 25 yr event
 Inflow = 2.90 cfs @ 12.20 hrs, Volume= 7,367 cf
 Outflow = 1.62 cfs @ 12.32 hrs, Volume= 7,365 cf, Atten= 44%, Lag= 7.0 min
 Discarded = 0.46 cfs @ 12.32 hrs, Volume= 5,109 cf
 Primary = 1.16 cfs @ 12.32 hrs, Volume= 2,256 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 11.75' @ 12.32 hrs Surf.Area= 2,384 sf Storage= 1,418 cf

Plug-Flow detention time= 20.4 min calculated for 7,365 cf (100% of inflow)
 Center-of-Mass det. time= 20.2 min (792.5 - 772.3)

Volume	Invert	Avail.Storage	Storage Description
#1	7.50'	372 cf	5.00'W x 10.25'L x 2.04'H Cultec Stone Bed x 12 1,255 cf Overall - 326 cf Embedded = 929 cf x 40.0% Voids
#2	8.00'	326 cf	Cultec R-150XLHD x 12 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
#3	9.50'	62 cf	5.00'W x 10.25'L x 0.25'H Pea Gravel Storage x 12 154 cf Overall x 40.0% Voids
#4	9.75'	90 cf	Bio Soil Mix Storage (Conic) Listed below (Recalc) 300 cf Overall x 30.0% Voids
#5	10.75'	764 cf	Freeboard Storage (Conic) Listed below (Recalc)
#6	8.00'	16 cf	2.00'W x 2.00'L x 4.00'H Yard Drain Storage
			1,629 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
9.75	300	0	0	300
10.75	300	300	300	361

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
10.75	300	0	0	300
11.75	850	552	552	856
12.00	850	213	764	882

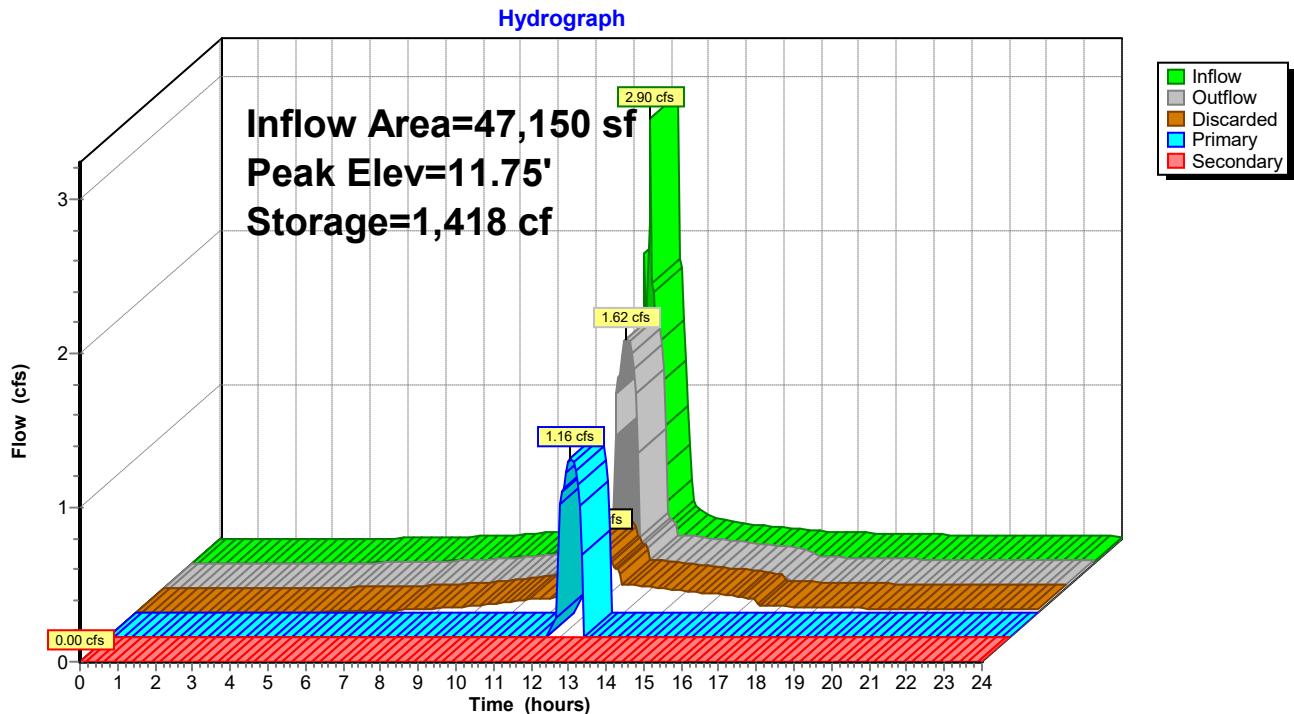
Device	Routing	Invert	Outlet Devices
#1	Discarded	7.50'	6.000 in/hr Exfiltration over Wetted area
#2	Secondary	11.75'	16.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#3	Primary	10.00'	6.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.46 cfs @ 12.32 hrs HW=11.75' (Free Discharge)
 ↗ 1=Exfiltration (Exfiltration Controls 0.46 cfs)

Primary OutFlow Max=1.16 cfs @ 12.32 hrs HW=11.75' (Free Discharge)
 ↗ 3=Orifice/Grate (Orifice Controls 1.16 cfs @ 5.89 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=7.50' (Free Discharge)
 ↗ 2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond RG1: Rain Garden W/ Cultec R-150 XLHD Rechargers



Stage-Area-Storage for Pond RG1: Rain Garden W/ Cultec R-150 XLHD Rechargers

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
7.50	615	0	10.10	2,410	799
7.55	633	12	10.15	2,414	803
7.60	652	25	10.20	2,417	808
7.65	670	37	10.25	2,421	813
7.70	688	49	10.30	2,424	818
7.75	707	62	10.35	2,428	822
7.80	725	74	10.40	2,431	827
7.85	743	86	10.45	2,435	832
7.90	761	98	10.50	2,438	836
7.95	780	111	10.55	2,442	841
8.00	802	123	10.60	2,445	846
8.05	821	145	10.65	2,449	850
8.10	839	166	10.70	2,452	855
8.15	858	187	10.75	2,756	860
8.20	877	209	10.80	2,777	876
8.25	896	230	10.85	2,799	892
8.30	914	251	10.90	2,822	910
8.35	933	272	10.95	2,846	929
8.40	952	293	11.00	2,870	949
8.45	970	314	11.05	2,895	971
8.50	989	334	11.10	2,921	993
8.55	1,008	355	11.15	2,947	1,017
8.60	1,026	376	11.20	2,974	1,042
8.65	1,045	396	11.25	3,002	1,069
8.70	1,064	416	11.30	3,031	1,097
8.75	1,083	436	11.35	3,060	1,126
8.80	1,101	456	11.40	3,090	1,157
8.85	1,120	476	11.45	3,121	1,189
8.90	1,139	495	11.50	3,152	1,223
8.95	1,157	514	11.55	3,184	1,258
9.00	1,176	533	11.60	3,217	1,295
9.05	1,195	552	11.65	3,251	1,333
9.10	1,213	570	11.70	3,285	1,374
9.15	1,232	588	11.75	3,320	1,415
9.20	1,251	605	11.80	3,325	1,458
9.25	1,270	622	11.85	3,331	1,501
9.30	1,288	638	11.90	3,336	1,544
9.35	1,307	653	11.95	3,342	1,586
9.40	1,326	667	12.00	3,348	1,629
9.45	1,344	680			
9.50	1,978	693			
9.55	2,011	716			
9.60	2,030	728			
9.65	2,049	741			
9.70	2,067	753			
9.75	2,386	766			
9.80	2,390	771			
9.85	2,393	775			
9.90	2,397	780			
9.95	2,400	785			
10.00	2,403	789			
10.05	2,407	794			

Summary for Pond RG2: Rain Garden W/ Cultec R-150 XLHD Rechargers

Inflow Area = 22,400 sf, 92.19% Impervious, Inflow Depth > 5.81" for 25 yr event
 Inflow = 3.43 cfs @ 12.05 hrs, Volume= 10,841 cf
 Outflow = 3.35 cfs @ 12.05 hrs, Volume= 10,837 cf, Atten= 2%, Lag= 0.3 min
 Discarded = 0.36 cfs @ 12.05 hrs, Volume= 7,909 cf
 Primary = 2.99 cfs @ 12.05 hrs, Volume= 2,928 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 10.36' @ 12.05 hrs Surf.Area= 1,919 sf Storage= 1,233 cf

Plug-Flow detention time= 27.8 min calculated for 10,837 cf (100% of inflow)
 Center-of-Mass det. time= 27.5 min (786.7 - 759.2)

Volume	Invert	Avail.Storage	Storage Description
#1	6.00'	248 cf	5.00'W x 10.25'L x 2.04'H Cultec Stone Bed x 8 836 cf Overall - 217 cf Embedded = 619 cf x 40.0% Voids
#2	6.50'	217 cf	Cultec R-150XLHD x 8 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
#3	8.00'	41 cf	5.00'W x 10.25'L x 0.25'H Pea Gravel x 8 103 cf Overall x 40.0% Voids
#4	8.25'	95 cf	Bio Soil Mix Storage (Conic) Listed below (Recalc) 315 cf Overall x 30.0% Voids
#5	9.25'	725 cf	Freeboard Storage (Conic) Listed below (Recalc)
#6	6.00'	20 cf	2.00'W x 2.00'L x 5.00'H Catch Basin Storage
			1,346 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8.25	315	0	0	315
9.25	315	315	315	378

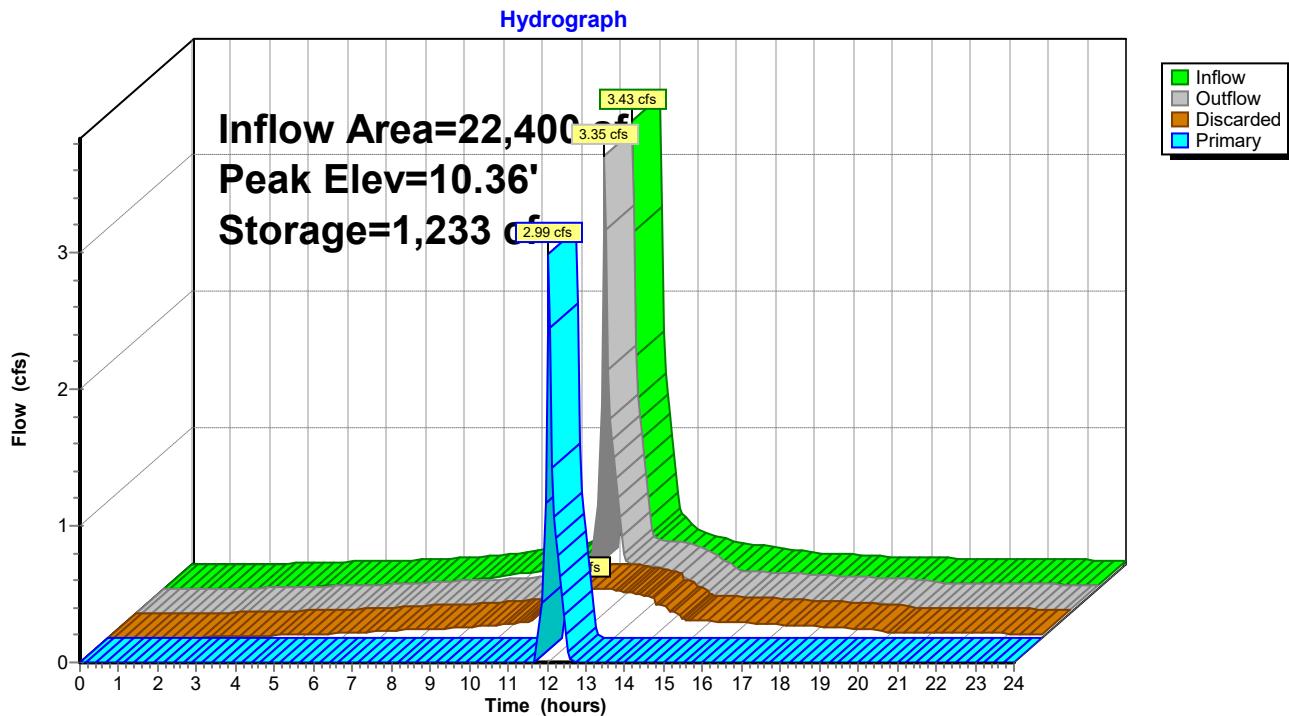
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
9.25	315	0	0	315
10.25	780	530	530	787
10.50	780	195	725	812

Device	Routing	Invert	Outlet Devices
#1	Discarded	6.00'	6.000 in/hr Exfiltration over Wetted area
#2	Primary	10.25'	25.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Discarded OutFlow Max=0.36 cfs @ 12.05 hrs HW=10.36' (Free Discharge)
 ↗1=Exfiltration (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=2.95 cfs @ 12.05 hrs HW=10.36' (Free Discharge)
 ↗2=Sharp-Crested Rectangular Weir (Weir Controls 2.95 cfs @ 1.08 fps)

Pond RG2: Rain Garden W/ Cultec R-150 XLHD Rechargers



Stage-Area-Storage for Pond RG2: Rain Garden W/ Cultec R-150 XLHD Rechargers

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
6.00	414	0	8.60	1,741	549
6.05	427	8	8.65	1,744	554
6.10	439	17	8.70	1,748	559
6.15	452	25	8.75	1,751	564
6.20	464	34	8.80	1,755	569
6.25	477	42	8.85	1,758	574
6.30	490	50	8.90	1,762	579
6.35	502	59	8.95	1,765	584
6.40	515	67	9.00	1,769	589
6.45	527	76	9.05	1,772	594
6.50	540	84	9.10	1,776	599
6.55	553	98	9.15	1,780	604
6.60	565	113	9.20	1,783	608
6.65	578	127	9.25	2,102	613
6.70	590	141	9.30	2,121	630
6.75	603	155	9.35	2,140	647
6.80	616	170	9.40	2,160	665
6.85	628	184	9.45	2,181	685
6.90	641	198	9.50	2,202	705
6.95	653	212	9.55	2,224	726
7.00	666	226	9.60	2,246	749
7.05	679	239	9.65	2,268	772
7.10	691	253	9.70	2,292	797
7.15	704	267	9.75	2,315	822
7.20	716	280	9.80	2,340	849
7.25	729	294	9.85	2,364	877
7.30	742	307	9.90	2,390	907
7.35	754	320	9.95	2,416	937
7.40	767	333	10.00	2,442	969
7.45	779	346	10.05	2,469	1,002
7.50	792	359	10.10	2,496	1,036
7.55	805	371	10.15	2,524	1,072
7.60	817	383	10.20	2,553	1,109
7.65	830	395	10.25	2,582	1,148
7.70	842	407	10.30	2,587	1,187
7.75	855	418	10.35	2,592	1,226
7.80	868	429	10.40	2,598	1,265
7.85	880	439	10.45	2,603	1,304
7.90	893	448	10.50	2,608	1,344
7.95	905	458	10.55	2,609	1,344
8.00	1,328	466	10.60	2,609	1,344
8.05	1,350	481	10.65	2,610	1,344
8.10	1,363	490	10.70	2,610	1,344
8.15	1,376	498	10.75	2,610	1,345
8.20	1,388	506	10.80	2,611	1,345
8.25	1,716	515	10.85	2,611	1,345
8.30	1,719	520	10.90	2,612	1,345
8.35	1,723	525	10.95	2,612	1,345
8.40	1,726	530	11.00	2,612	1,346
8.45	1,730	535			
8.50	1,733	540			
8.55	1,737	544			

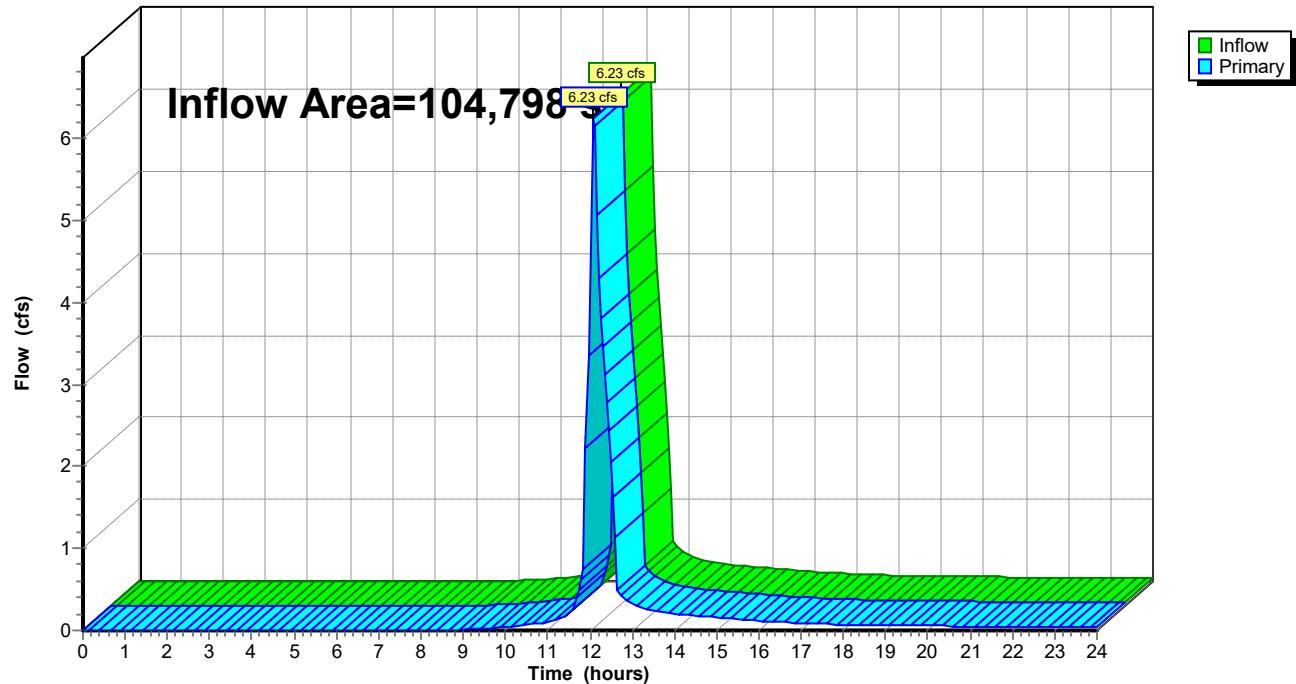
Summary for Link OR: Overall Runoff

Inflow Area = 104,798 sf, 61.50% Impervious, Inflow Depth > 1.68" for 25 yr event
Inflow = 6.23 cfs @ 12.08 hrs, Volume= 14,642 cf
Primary = 6.23 cfs @ 12.08 hrs, Volume= 14,642 cf, Atten= 0%, Lag= 0.0 min

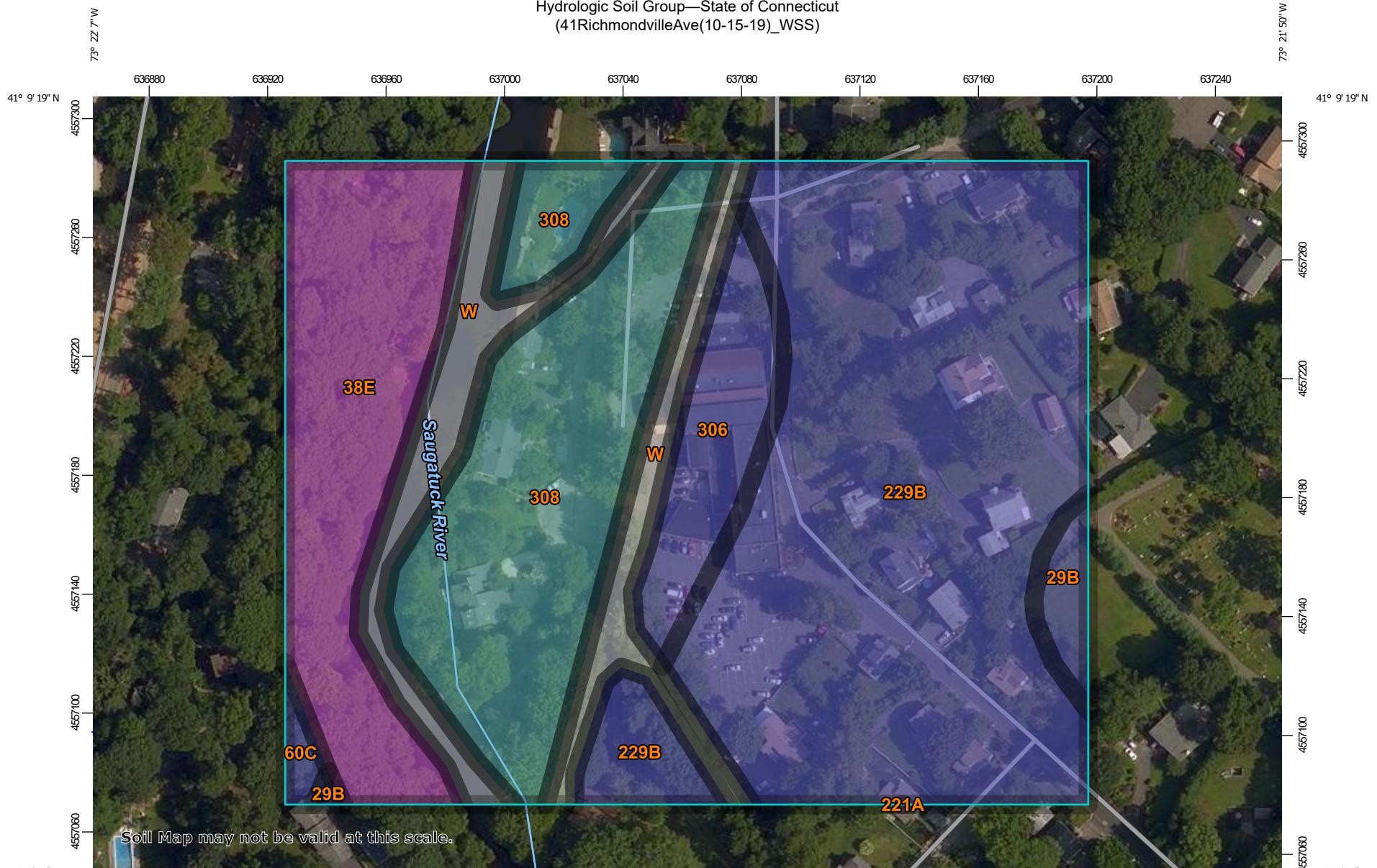
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link OR: Overall Runoff

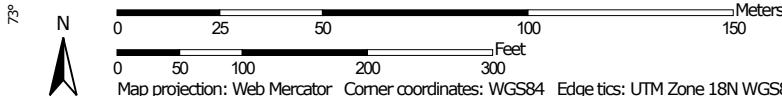
Hydrograph



Hydrologic Soil Group—State of Connecticut
(41RichmondvilleAve(10-15-19)_WSS)



Map Scale: 1:1,840 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

10/15/2019
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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
29B	Agawam fine sandy loam, 3 to 8 percent slopes	B	0.2	1.6%
38E	Hinckley loamy sand, 15 to 45 percent slopes	A	2.3	15.7%
60C	Canton and Charlton fine sandy loams, 8 to 15 percent slopes	B	0.1	0.7%
221A	Ninigret-Urban land complex, 0 to 5 percent slopes	B	0.0	0.0%
229B	Agawam-Urban land complex, 0 to 8 percent slopes	B	6.5	44.8%
306	Udorthents-Urban land complex	B	0.9	6.0%
308	Udorthents, smoothed	C	3.0	20.8%
W	Water		1.5	10.5%
Totals for Area of Interest			14.6	100.0%

